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(54) IMAGE ENCODING METHODIMAGE DECODING METHODIMAGE ENCODING APPARATUSIMAGE DECODING APPARATUSIMAGE PROCESSING SYSTEMIMAGE ENCODING PROGRAMAND IMAGE DECODING PROGRAM

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an image encoding apparatus capable of efficient entropy encoding in orthogonal conversion of variable size.
SOLUTION: This image encoding apparatus 10 is provided with a block selecting means 14 for dividing an image signal into blocks to perform orthogonal conversionreading an obtained orthogonal conversion coefficient to form it into a coefficient series and performing entropy encoding for the coefficient seriesand selecting the size of a block to be subjected to orthogonal conversion from among a plurality of blocks having different sizes; a coefficient series dividing means 12 for dividing a coefficient series in a block having a size lager than the minimum size into a plurality of coefficient series having the same size as that of a coefficient series in a block of the minimum size when the coefficient series having a size larger than the minimum size is selected in the means 14; and an encoding means 13 for performing entropy encoding adapted to the coefficient series in the block of the minimum size.

CLAIMS

[Claim(s)]
[Claim 1]
After reading an orthogonal transformation coefficient obtained by dividing a picture signal into a block and performing orthogonal transformation and considering it as a coefficient sequenceit is an image encoding method which carries out entropy code modulation
A block selection step which chooses size of a block which performs said orthogonal transformation from several blocks with which sizes differ
A coefficient sequence division step which divides a coefficient sequence in the block into two or more coefficient sequences of the same length as a coefficient sequence in a block of said minimum size when a block of large size is chosen from the minimum size in said block selection step
A coding step for performing entropy code modulation which was adapted for said coefficient sequence in a block of said minimum size
An image encoding method characterized by preparation ******.
[Claim 2]
Said image encoding method according to claim 1 acquiring a coefficient sequence after division by said coefficient sequence division step's reading a coefficient sequence from a coefficient of a low frequency regionand assigning one at a time in order to two or more same coefficient sequences of length as a coefficient sequence in a block of the minimum sizerespectively.
[Claim 3]
By repeating that said coefficient sequence division step reads a coefficient sequence from a coefficient of a low frequency regionreads a coefficient of the number of coefficients and the same number which a coefficient sequence in a block of the minimum size hasand makes it a coefficient sequence after divisionSaid image encoding method according to claim 1 acquiring a coefficient sequence after division.
[Claim 4]
After reading an orthogonal transformation coefficient obtained by dividing a picture signal into a block and performing orthogonal transformation and considering it as a coefficient sequenceit is an image decoding method which decodes coding data coded by an image encoding method which carries out entropy code modulation
A block selection step which chooses size of a block which performs said orthogonal transformation from several blocks with which sizes differ
A decoding step for decoding coding data based on entropy code modulation which was adapted for said coefficient sequence in a block of the minimum size

in a block of said plurality
A coefficient sequence composition step which constitutes a coefficient sequence of a block of the large size concerned from two or more coefficient sequences decoded in said decoding step when a block of large size is chosen from said minimum size in said block selection step
An image decoding method characterized by preparation ******.
[Claim 5]
Said coefficient sequence composition step reads two or more coefficient sequences decoded in said decoding step from a coefficient of a low frequency regionand. Said image decoding method according to claim 4 which uses in order every one coefficient read from each coefficient sequencewrites in a new coefficient sequence from a low frequency regionand is characterized by considering it as a coefficient sequence after constituting this.
[Claim 6]
Said coefficient sequence composition step reads two or more coefficient sequences decoded in said decoding step from a coefficient of a low frequency regionand. Said image decoding method according to claim 4 which writes a read coefficient in a new coefficient sequence from a low frequency region for every coefficient sequence of read-out originand is characterized by considering it as a coefficient sequence after constituting this.
[Claim 7]
After reading an orthogonal transformation coefficient obtained by dividing a picture signal into a block and performing orthogonal transformation and considering it as a coefficient sequenceit is an image encoding apparatus which carries out entropy code modulation
A block selecting means which chooses size of a block which performs said orthogonal transformation from several blocks with which sizes differ
A coefficient sequence division means to divide a coefficient sequence in the block into two or more coefficient sequences of the same length as a coefficient sequence in a block of said minimum size when a block of larger size than the minimum size is chosen by said block selecting means
An encoding means for performing entropy code modulation which was adapted for said coefficient sequence in a block of said minimum size
An image encoding apparatus characterized by preparation ******.
[Claim 8]
Said image encoding apparatus according to claim 7 acquiring a coefficient sequence after division by said coefficient sequence division means' reading a coefficient sequence from a coefficient of a low frequency regionand assigning one at a time in order to two or more same coefficient sequences of length as a coefficient sequence in a block of the minimum sizerespectively.
[Claim 9]

By repeating that said coefficient sequence division means reads a coefficient sequence from a coefficient of a low frequency regionreads a coefficient of the number of coefficients and the same number which a coefficient sequence in a block of the minimum size hasand makes it a coefficient sequence after divisionSaid image encoding apparatus according to claim 7 acquiring a coefficient sequence after division.

[Claim 10]

After reading an orthogonal transformation coefficient obtained by dividing a picture signal into a block and performing orthogonal transformation and considering it as a coefficient sequenceit is an image decoding device which decodes coding data coded by an image encoding method which carries out entropy code modulation

A block selecting means which chooses size of a block which performs said orthogonal transformation from several blocks with which sizes differ

A decoding means for decoding coding data based on entropy code modulation which was adapted for said coefficient sequence in a block of the minimum size in a block of said plurality

A coefficient sequence constituent means which constitutes a coefficient sequence of a block of the large size concerned from two or more coefficient sequences decoded by said decoding means when a block of larger size than said minimum size is chosen by said block selecting means

An image decoding device characterized by preparation ******.

[Claim 11]

Said coefficient sequence constituent means reads two or more coefficient sequences decoded by said decoding means from a coefficient of a low frequency regionand. Said image decoding device according to claim 10 which uses in order every one coefficient read from each coefficient sequencewrites in a new coefficient sequence from a low frequency regionand is characterized by considering it as a coefficient sequence after constituting this.

[Claim 12]

Said coefficient sequence constituent means reads two or more coefficient sequences decoded by said decoding means from a coefficient of a low frequency regionand. Said image decoding device according to claim 10 which writes a read coefficient in a new coefficient sequence from a low frequency region for every coefficient sequence of read-out originand is characterized by considering it as a coefficient sequence after constituting this.

[Claim 13]

An image processing system comprising:

An image encoding apparatus given in any 1 paragraph of claims 7-9.

An image decoding device given in any 1 paragraph of claims 10-12.

[Claim 14]
After reading an orthogonal transformation coefficient obtained by dividing a picture signal into a block and performing orthogonal transformation and considering it as a coefficient sequencein order to carry out entropy code modulationit is to a computer
A block selection step which chooses size of a block which performs said orthogonal transformation from several blocks with which sizes differ
A coefficient sequence division step which divides a coefficient sequence in the block into two or more coefficient sequences of the same length as a coefficient sequence in a block of said minimum size when a block of large size is chosen from the minimum size in said block selection step
A coding step for performing entropy code modulation which was adapted for said coefficient sequence in a block of said minimum size
An image coding program making it perform.
[Claim 15]
By said coefficient sequence division step's reading a coefficient sequence from a coefficient of a low frequency regionand assigning one at a time in order to two or more same coefficient sequences of length as a coefficient sequence in a block of the minimum sizerespectivelySaid image coding program according to claim 14 acquiring a coefficient sequence after division.
[Claim 16]
By repeating that said coefficient sequence division step reads a coefficient sequence from a coefficient of a low frequency regionreads a coefficient of the number of coefficients and the same number which a coefficient sequence in a block of the minimum size hasand makes it a coefficient sequence after divisionSaid image coding program according to claim 14 acquiring a coefficient sequence after division.
[Claim 17]
After reading an orthogonal transformation coefficient obtained by dividing a picture signal into a block and performing orthogonal transformation and considering it as a coefficient sequenceA block selection step which chooses as a computer size of a block which performs said orthogonal transformation from several blocks with which sizes differ in order to decode coding data coded by an image encoding method which carries out entropy code modulation
A decoding step for decoding coding data based on entropy code modulation which was adapted for said coefficient sequence in a block of the minimum size in a block of said plurality
A coefficient sequence composition step which constitutes a coefficient sequence of a block of the large size concerned from two or more coefficient sequences decoded in said decoding step when a block of large size is chosen from said minimum size in said block selection step

An image decoding program making it perform.
[Claim 18]
Said coefficient sequence composition step reads two or more coefficient sequences decoded in said decoding step from a coefficient of a low frequency regionand. Said image decoding program according to claim 17 which uses in order every one coefficient read from each coefficient sequencewrites in a new coefficient sequence from a low frequency regionand is characterized by considering it as a coefficient sequence after constituting this.
[Claim 19]
Said coefficient sequence composition step reads said two or more coefficient sequences by which decoding step decoding was carried out from a coefficient of a low frequency regionand. Said image decoding program according to claim 17 which writes a read coefficient in a new coefficient sequence from a low frequency region for every coefficient sequence of read-out originand is characterized by considering it as a coefficient sequence after constituting this.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]
When the size of the block which performs orthogonal transformation can be chosen from pluralitythis inventionIt is related with the image encoding methodthe image decoding methodthe image encoding apparatusthe image decoding devicethe image processing systemimage coding programand image decoding program which make possible efficient entropy code modulation of an orthogonal transformation coefficient.
[0002]
[Description of the Prior Art]
In order to perform transmission and store and forward of switching signal of a picture signal of a still picturevideoetc.the coding technology of a picture signal is used. As such artas coding technology of a still pictureISO/IEC International Standard 10918 (referred to as JPEG below)As coding technology of videothe international standardization coding mode of ISO/IEC International Standard 14496-2 (referred to as MPEG-4 Visual and following MPEG-4) etc. is known. The video coding mode with which the joint international standardization of ITU-T and ISO/IEC is planned as a newer coding modeITU-TRecommendation. H. 264 and ISO/IEC International Standard 14496-10 () [Joint Final Committee Draft of Joint Video Specification and] ftp//ftp.imtc-

files.org/jvt-experts/200207 Klagenfurt/JVT-D157.zipand following H.26L -- calling -- it is known.The general coding technology used for these image coding systems is indicated to the nonpatent literature 1for example.
[0003]
In a picture signalsince correlation between the pixels which adjoin spatially is largewhen it changes into a frequency domaininformation will incline toward a low frequency regionand the redundant reduction using this bias is attained. Soin a general image coding systemorthogonal transformation is carried out to a picture signalit changes into it to the orthogonal transformation coefficient in a frequency domainand a signal component is biased toward a low frequency regionand it quantizes to this coefficient value furtherand let a coefficient with a small value be a zero value. After reading sequentially from the coefficient of this low frequency region and considering it as a coefficient sequenceentropy code modulation using the bias of the coefficient value is performedand the efficient coding which reduced redundancy is realized.
[0004]
In this caseas orthogonal transformationthe discrete cosine transform (Discrete Cosine TransformDCT) is widely used from encoding efficiency or a point of the ease of mounting. The orthogonal transformation by DCT etc. divides a picture signal into the block which comprises two or more pixelsand is performed in the unit of this block. The size of this block influences encoding efficiency greatly with the character of a picture signal.
[0005]
If change of the spatial character in a picture signal is smallthe picture signal changed into the orthogonal transformation coefficient of the same frequency domain from being widely distributed on a picture. By enlarging the size of a blocki.e.the size of orthogonal transformationwhen a small block is usedas compared with repeating and expressing the same orthogonal transformation coefficientredundancy can be reduced more now and encoding efficiency improves. If change of the spatial character in a picture signal is large on another side and the size of a block will be enlargedit will become difficult from various frequency components being contained in the orthogonal transformation coefficientand the bias of a coefficient becoming small to perform efficient entropy code modulationand encoding efficiency will get worse.
[0006]
In order to use change of the encoding efficiency by change of such a size of the block which performs orthogonal transformationand the character of a picture signalThe orthogonal transformation means in the size of two or more blocks is prepared beforehandand the art of choosing the size from which the

best encoding efficiency is acquired out of them accommodativeand using it is used. This art is called adaptive block size orthogonal transformation (Adaptive Block size TransformsABT)and is adopted in H.26L. The orthogonal transformation block used for drawing 1 in ABT in H.26L is shown. In ABTthe size from which the best encoding efficiency is acquired out of four kinds of orthogonal transformation block sizes shown in drawing 1 (b) - (e) can be chosen for every 16x16 pixels [which is shown in drawing 1 (a)] macro block. To the pixel value of a macro blocka division-into-equal-parts rate will be carried out by the block of the selected sizeand orthogonal transformation will be performed. By performing such selectionredundant reduction using orthogonal transformation can be efficiently performed to compensate for change of the spatial character of the picture signal in a macro block. Please refer to H.26L for the more concrete details of ABT.

[0007]

Entropy code modulation to the orthogonal transformation coefficient obtained by orthogonal transformation is performed about the coefficient sequence which read the orthogonal transformation coefficient sequentially from the coefficient of a low frequency region. The order of read-out of the coefficient in a 4x4-pixel orthogonal transformation block is shown in drawing 2 (a). Since the coefficient produced by performing orthogonal transformation is most arranged as an ingredient (namelydc component) of a low frequency wave in the upper leftit reads sequentially from an upper left coefficientand acquires the coefficient sequence which consists of a coefficient of 16 pieces as shown in drawing 2 (b). Such order of read-out is called a zigzag scan.

[0008]

Since are-izing [the coefficient obtained by orthogonal transformation / no correlating] mutually and a signal component inclines toward a low frequency regionwhen this is quantized furthermany coefficients which it becomes a coefficient value of non-zero as the coefficient of a low frequency regionand serve as a zero value into a coefficient sequence appear. For exampleit becomes a row of a coefficient value as shown in drawing 2 (c). Thenin order to carry out entropy code modulation of the coefficient sequence of such distribution efficientlyit codes by the coefficient value (level) of the consecutive number (run) of a zero coefficient and a non-zero coefficient which precedes a coefficient sequence with a non-zero coefficient generally expressing in image coding. The coding by such a run and a level is used also about the entropy code modulation of the orthogonal transformation coefficient by ABT.

[0009]

In order for the time of performing such entropy code modulation to raise efficiency on the other handContext adaptation variable length code ()

[Context-based Adaptive Variable Length Code and] the art called CAVLC is adopted in H.26Land it is used when the orthogonal transformation when not using ABTi.e.orthogonal transformationis always performed in the unit of a 4x4-pixel orthogonal transformation block.

[0010]

H. The coefficient contained in the coefficient sequence acquired from a 4x4-pixel orthogonal transformation block in CAVLC in 26L is 16 pieces at the maximumand the size of a run is restricted with this maximum numberThe size of a level is raising encoding efficiency by preparing many encoding tables used for variable length coding as what was optimized for every condition using being easy to become a big value as the thing of a low frequency regionchanging this one by one and applying it.

[0011]

For examplewhen coding each run in orderin the first runcan take various values from 0 to 14 (H. the maximum number of a run is set to 14 only with less 2 than the total number of coefficients by the definition of the run in 26L)but. In the run in the direction of the end after coding a run in orderonly the value of the limited run cannot be taken from the number of the coefficients contained in a coefficient sequence having a maximum. Thereforeas shown in drawing 3in the run in the direction of the firstthe encoding table of right-hand side with most elements of an encoding table is usedBy applying the encoding table of the left-hand side which made the number of elements of the encoding table smallthe numerals of the smaller number of bits can be assigned and entropy code modulation can be efficiently performed as it becomes the run of the last direction. In CAVLCefficient coding is realized by adding restriction to the range which the value which should be coded can take using conditionssuch as the maximum number etc. of the coefficient contained in a block in this way. Please refer to H.26L for the more concrete details of CAVLC.

[0012]

[Nonpatent literature 1]

Basic technology of international-standards image codingOno FumitakaWatanabe The Yutaka collaborationCorona Publishing

[0013]

[Problem(s) to be Solved by the Invention]

By applying the above CAVLC(s) to ABTit is expectable to realize more efficient entropy code modulation also in the coefficient sequence of ABT.

[0014]

HoweverCAVLC optimizes the encoding table used for variable length coding while it is based on the maximum number of the coefficient contained in a block for every conditionand it is raising encoding efficiency by using for

codingchanging this.
[0015]
The numbers of coefficients from which size differs when ABT is used and which are contained for every block differand 8x4 of 64 piecesdrawing 1 (c)and (d)and in the case of 4x8 blocksin the case of 4x4 blocks of 32 pieces and drawing 1 (e)it becomes 16 pieces in being 8x8 blocks of drawing 1 (b). For this reasonin order to apply CAVLCit will be necessary to take into consideration a huge number of conditions which may happen in each case.
[0016]
For exampleas shown in the encoding table of the run shown in drawing 3when it is going to set up an encoding table according to a number of a coefficient of maximums contained in a coefficient sequenceIn the case of 8x8 blocks used as the number of coefficients of 64 piecesit will be necessary to prepare a huge number of with a number of elements an encoding table with two elements to 62 encoding tables of encoding tables. Also in 8x4 used as the number of coefficients of 32 piecesand 4x8 blocksthe encoding table from two elements to 30 elements will be prepared like this.
[0017]
Thusin the orthogonal transformation which chooses and uses the orthogonal transformation block with which sizes differ like ABTWhen it was going to apply the entropy code modulation adapted to the characteristic of the coefficient like CAVLCthere was a problem that the number of the encoding tables which should be prepared will become hugeand memory quantity required for maintenance of an encoding table will become huge. Since the encoding table used about the block of each size would differ from its selection procedurerespectivelythere was a problem that the procedure in entropy code modulation will become complicatedand a realization means and an equipment configuration will become complicated.
[0018]
This invention is made in order to solve the above problemand it is a thing. The purpose is to provide the image encoding methodthe image decoding methodthe image encoding apparatusthe image decoding devicethe image processing systemimage coding programand image decoding program which make possible efficient entropy code modulation in the orthogonal transformation of **.

[0019]
[Means for Solving the Problem]
In order to attain such a purposean image encoding method (device) concerning this invention is provided with the following.
A block selection step which chooses size of a block which performs orthogonal

transformation from several blocks with which it is an image encoding method (device) which carries out entropy code modulationand sizes differ after reading an orthogonal transformation coefficient obtained by dividing a picture signal into a block and performing orthogonal transformation and considering it as a coefficient sequence (a device).
A coefficient sequence division step which divides a coefficient sequence in the block into two or more coefficient sequences of the same length as a coefficient sequence in a block of the minimum size when a block of large size is chosen from the minimum size in a block selection step (MEANS) (MEANS).
A coding step for performing entropy code modulation which was adapted for a coefficient sequence in a block of the minimum size (MEANS).
An image coding program concerning this invention makes a computer perform each above-mentioned step.
[0020]
Thusin an image encoding method concerning this inventionwhen a block of big size is chosen and orthogonal transformation is performedafter dividing a coefficient sequence in the blockit is supposed that entropy code modulation is performed. Therebyin entropy code modulation of a coefficient sequenceefficient entropy code modulation of an orthogonal transformation coefficient can be realizedwithout being able to use entropy code modulation which was adapted for a coefficient sequence in a block of the minimum sizeand making a procedure of entropy code modulation complicate.
[0021]
In a described image encoding method (device)a coefficient sequence division step (a device) is good also considering acquiring a coefficient sequence after division as a feature by reading a coefficient sequence from a coefficient of a low frequency regionand assigning one at a time in order to two or more same coefficient sequences of length as a coefficient sequence in a block of the minimum sizerespectively. A coefficient sequence division step which a computer is made to perform also in a described image encoding programIt is good also considering acquiring a coefficient sequence after division as a feature by reading a coefficient sequence from a coefficient of a low frequency regionand assigning one at a time in order to two or more same coefficient sequences of length as a coefficient sequence in a block of the minimum sizerespectively.
[0022]
In a described image encoding method (device)a coefficient sequence division step (a device) is good also considering acquiring a coefficient sequence after division as a feature by repeating reading a coefficient sequence from a coefficient of a low frequency regionreading a coefficient of the number of coefficients and the same number which a coefficient sequence in a block of

the minimum size hasand considering it as a coefficient sequence after division. A coefficient sequence division step which a computer is made to perform also in a described image encoding programIt is good also considering acquiring a coefficient sequence after division as a feature by repeating reading a coefficient sequence from a coefficient of a low frequency regionreading a coefficient of the number of coefficients and the same number which a coefficient sequence in a block of the minimum size hasand considering it as a coefficient sequence after division.

[0023]

An image decoding method (device) concerning this invention is provided with the following.

A block selection step which chooses size of a block which performs orthogonal transformation from several blocks with which it is an image decoding method which decodes coding data coded by an image encoding method which carries out entropy code modulation after reading an orthogonal transformation coefficient obtained by dividing a picture signal into a block and performing orthogonal transformation and considering it as a coefficient sequenceand sizes differ (MEANS).

A decoding step for decoding coding data based on entropy code modulation which was adapted for a coefficient sequence in a block of the minimum size in two or more blocks (MEANS).

A coefficient sequence composition step which constitutes a coefficient sequence of a block of the large size concerned from two or more coefficient sequences decoded in a decoding step (MEANS) when a block of large size is chosen from the minimum size in a block selection step (MEANS) (MEANS).

An image decoding program concerning this invention makes a computer perform each above-mentioned step.

[0024]

Thusin an image decoding method concerning this inventionwhen decoding coding data in which a block of big size was chosen and orthogonal transformation was performedit is supposed that a coefficient sequence in the block is constituted from a coefficient sequence of a block included by the block. Efficient entropy code modulation of an orthogonal transformation coefficient can be realized without being able to decode a coefficient sequence by this from coding data using entropy code modulation which was adapted for a coefficient sequence in a block of the minimum sizeand making a procedure of decoding of entropy code modulation complicate.

[0025]

In a described image decoding method (device)a coefficient sequence composition step (a device) reads two or more coefficient sequences decoded in a decoding step (a device) from a coefficient of a low frequency regionand it

is good also considering using in order every one coefficient read from each coefficient sequencewriting it in a new coefficient sequence from a low frequency regionand making it into a coefficient sequence after constituting this as a feature. A coefficient sequence composition step which a computer is made to perform also in the above-mentioned decoded programTwo or more coefficient sequences decoded in a decoding step are read from a coefficient of a low frequency regionand it is good also considering using in order every one coefficient read from each coefficient sequencewriting it in a new coefficient sequence from a low frequency regionand making it into a coefficient sequence after constituting this as a feature.

[0026]

In a described image decoding method (device)a coefficient sequence composition step (a device) reads two or more coefficient sequences decoded in a decoding step (a device) from a coefficient of a low frequency regionand it is good also considering writing a read coefficient in a new coefficient sequence from a low frequency region for every coefficient sequence of read-out originand considering it as a coefficient sequence after constituting this as a feature. A coefficient sequence composition step which a computer is made to perform also in a described image decoding programTwo or more coefficient sequences decoded in a decoding step are read from a coefficient of a low frequency regionand it is good also considering writing a read coefficient in a new coefficient sequence from a low frequency region for every coefficient sequence of read-out originand considering it as a coefficient sequence after constituting this as a feature.

[0027]

An image processing system concerning this invention is provided with described image coding equipment and a described image decoding device.

[0028]

By having described image coding equipmentmake possible efficient entropy code modulation in orthogonal transformation of variable sizeand. By having a described image decoding devicean image processing system which can decode numerals by which entropy code modulation was carried out with described image coding equipment is realizable.

[0029]

[Embodiment of the Invention]

Hereafterthe suitable embodiment of the image encoding method by this inventionan image decoding methodan image encoding apparatusan image decoding deviceand an image processing system is described in detail with a drawing. In explanation of a drawingidentical codes are given to the same element and the overlapping explanation is omitted to it.

[0030]

In the following the coding and decodings in explanationit shall explain as realizing based on H.26Land shall apply to operation of H.26L correspondingly about the portion which is not touching on the operation in particular in image coding. Howeverthis invention is not limited to H.26L.

[0031]

The embodiment of this invention is described. In the coding by this embodimentabout the orthogonal transformation coefficient of a block of each size of ABT in H.26L. It enables it to carry out entropy code modulation by CAVLC of H.26L which adapted to 4x4 blocks and was defined by dividing the coefficient sequence acquired from this into two or more coefficient sequences which consist of the same number as the number of the coefficients in a 4x4-block coefficient sequence.

[0032]

In codingfirstABT in H.26L shall be applied to one macro blockthe size from which the best encoding efficiency is acquired out of the block shown in drawing 1 (b) - (e) shall be chosenand orthogonal transformation shall be made in the unit of the block.

[0033]

CAVLC in H.26L shall be used as entropy code modulation of an orthogonal transformation coefficient. That isonly variable length coding adapted to coding of the orthogonal transformation coefficient about 4x4 blocks shown in drawing 1 (e) shall be defined.

[0034]

For example8x8 blocks of drawing 1 (b) should be chosen here. About these 8x8 blocksread-out operation of the following orthogonal transformation coefficients is performed. Firstthe coefficient of 64 pieces at 8x8 blocks is read by a zigzag scanas shown in drawing 4 (a)and a coefficient sequence as shown in drawing 4 (b) is acquired.

[0035]

nextthe number of coefficients [in / for this coefficient sequence / a 4x4-block coefficient sequence] -- the same -- it shall divide into four coefficient sequences which consist of coefficients of 16 pieces Herethe coefficient sequence after division is acquired by assigning by turns four coefficient sequencesrespectivelyreading the coefficient sequence of a basis from the coefficient of a low frequency region. This read-out operation is shown in drawing 4 (c) and (d). Since it is assigned to each coefficient sequence by turns from the coefficient of a low frequency regionto the 1st after-division coefficient sequence. The 0th in the coefficient sequence of a basisthe 4ththe 8thand the 12th continuing coefficient will be readrespectivelyand will be assignedand the 1stthe 5ththe 9thand the 13th continuing coefficient will be read to the 2nd after-division coefficient

sequencerespectivelyand will be assigned to it. In drawing 4it is omitting about the 3rd and 4th after-division coefficient sequence.

[0036]

Similarlywhen 8x4 blocks of drawing 1 (c) or (d) or 4x8 blocks are chosenthe coefficient of 32 pieces shall be divided into two coefficient sequences which consist of coefficients of 16 pieces. Except for the number of the coefficient sequences assigned by turns being set to 2 from 4it supposes that it is the same as that of the case of 8x8 blocksthe coefficient sequence of the basis is read from the coefficient of the low frequency regionand how to read for acquiring the coefficient sequence after division is also adopted to assign by turns two coefficient sequences.

[0037]

Thusentropy code modulation of the acquired coefficient sequence shall be carried out by the completely same procedure as coding of CAVLC in case ABT is not usedand it shall be outputted to order as coding data of the orthogonal transformation coefficient in an ABT block.

[0038]

At this timethe space context which changes the encoding table used based on the number of non-zero coefficients at adjoining 4x4 blocks is used by CAVLC of H.26L. For this reasonarrangement within the ABT block of the coefficient sequence after division is defined about a bigger ABT block than 4x4 blocks. This definition is shown in drawing 5. For examplein 8x8 blocks shown in drawing 5 (a)the 2nd after-division coefficient sequence that explained to the position of "1" again the 1st after-division coefficient sequence explained by drawing 4 (c) by drawing 4 (d) is treated in the position of "2" as what is arrangedrespectively. The space context about the after-division coefficient sequence within an ABT block or the space context about 4x4 blocks which adjoins an ABT block shall be treated the same at all with the technique in CAVLC in H.26L using the definition of this arrangement.

[0039]

In decodingthe orthogonal transformation procession of a basis can be acquired by a procedure contrary to the procedure in coding.

[0040]

ABT in H.26L shall be applied to one macro blocksize shall be directed out of the block shown in drawing 1 (b) - (e)and the orthogonal transformation performed in the unit of that ABT block shall be made in the coding data to this macro block.

[0041]

At this timethe coding data which carried out entropy code modulation of the after-division coefficient sequence by CAVLC will be contained in coding data in order as coding data of the orthogonal transformation coefficient in an ABT

block. Thereforethis is decoded one by one according to the procedure of CAVLCand an after-division coefficient sequence is acquired.
[0042]
Since the coefficient sequence after these division is a coefficient sequence divided depending on the method of read-out shown in drawing 4it can acquire the orthogonal transformation coefficient block of a basis by writing the coefficient of an after-division coefficient sequence in the coefficient sequence of a basis converselyand writing the coefficient sequence acquired further in an orthogonal transformation coefficient block. It is the same as the procedure of decoding when ABT in H.26L is applied henceforth.
[0043]
Nextthe composition of the image processing system 1 which realizes the above-mentioned image coding and image decoding is explained. Drawing 7 is a block diagram showing the image processing system 1 concerning an embodiment. The image processing system 1 is provided with the image encoding apparatus 10 and the image decoding device 20 which code image data.
[0044]
The image encoding apparatus 10 is provided with the following.
Orthogonal transformation means 11.
Coefficient sequence division means 12.
Entropy-code-modulation means 13.
Block selecting means 14.
The orthogonal transformation means 11 has a function which carries out orthogonal transformation of the image dataand changes into a frequency component. The orthogonal transformation means 11 divides the macro block of image data into two or more blocksand carries out orthogonal transformation of the divided block. It is connected with the block selecting means 14and the block which can perform orthogonal transformation most efficiently by the block selecting means 14 is chosen.
[0045]
The coefficient sequence division means 12 has the function to divide into a predetermined length-factor sequence the coefficient sequence acquired by orthogonal transformation. Herepredetermined lengthis the length of the coefficient sequence acquired when orthogonal transformation of the block of the minimum size is carried out among the blocks which may be divided when orthogonal transformation of the image data is carried out by the orthogonal transformation means 11.
[0046]
The entropy-code-modulation means 13 has a function which codes the coefficient sequence divided by the coefficient sequence division means 12. Since the coefficient sequence division means 12 is divided into the

coefficient sequence of a minimum blockand the coefficient sequence of the same length as described abovethe entropy-code-modulation means 13 can be considered as the composition adapted in order to code the coefficient sequence of the lengthand can be coded efficiently.

[0047]

The image decoding device 20 has the entropy decoding means 23the coefficient sequence constituent means 22the inverse-orthogonal-transformation means 21and the block selecting means 24. The entropy decoding means 23 has a function which decodes the coded data.

[0048]

The coefficient sequence constituent means 22 has a function which constitutes the divided coefficient sequence in the coefficient sequence of a basiswhen coded by the image encoding apparatus 10. It is connected to the block selecting means 24and the coefficient sequence constituent means 22 acquires the information about the size of the original block from the block selecting means 24and constitutes a coefficient sequence based on this information. The block selecting means 24 can acquire the size of the original block from an image encoding apparatus by the additional information etc. which are transmitted with coding data.

[0049]

The inverse-orthogonal-transformation means 21 has the function to change into image data the coefficient sequence constituted by the coefficient sequence constituent means 22.

[0050]

The image coding and image decoding which were mentioned above are realized by the image processing system 1 which has such composition.

[0051]

In this embodimentalthough read-out of an orthogonal transformation coefficient shall be based on a zigzag scanthe read method of the coefficient at the time of applying this invention is not restricted to a zigzag scan. For examplewhen the field scan for performing the field coding in an interlace picture defined in ABT of H.26L is appliedit is good also as applying this invention. Even in this casethe division technique of the coefficient sequence in this embodiment is applicable as it is.

[0052]

Although shown as what depends how to read in this embodiment for acquiring the coefficient sequence after division on mutual read-out as shown in drawing 4it is good also as performing the method of different read-out from thisand acquiring the coefficient sequence after division. For exampleas shown in drawing 6 (c) and (d)it is good also as reading 16 coefficient sequences of a basis at a time from the coefficient of the low frequency region

continuouslyand assigning even the coefficient sequence after dividing each.
[0053]
In this embodimentread-out of the orthogonal transformation coefficient in coding supposes that read-out of the second for acquiring two or more coefficient sequences after division after read-out of the first for acquiring a coefficient sequence from an orthogonal transformation block is performed. The writing of the orthogonal transformation coefficient in decoding supposes that the second writing for acquiring an orthogonal transformation block after the first writing for acquiring the coefficient sequence after composition is performed. Howeverread-out of the coefficient by this invention and writing are not restricted to theseand can take the various methods of reading and writing in that the coefficient sequence by desired arrangement is acquired. For examplein coefficient read-out of the first from an orthogonal transformation blockit may read so that two or more coefficient sequences after division may be acquired promptly. Also in the writing from an after-division coefficient sequenceit may carry out so that an orthogonal transformation block may be promptly acquired in the first coefficient writing.
[0054]
Although the coefficient sequence after division shall be arranged like drawing 5 and the space context from adjoining 4x4 blocks in CAVLC in H.26L shall be treated the same at all in this embodimentAt this timethe coefficient sequence divided from the coefficient sequence of the bigger ABT block than 4x4 blocks is good for the numerical value which is considered that character differs from the coefficient sequence at the time of being 4x4 blocks from the firstand is used as a space context also as performing weighting. Although the number of non-zero coefficients is specifically used as a space context from an adjoining blockWhen the number of non-zero coefficients about the after-division coefficient sequence acquired from the bigger ABT block than 4x4 blocks is used as a space contextit is good also as addition or the value which carried out multiplication always being used in a constant. Or as shown in drawing 6 againwhen the coefficient sequence after division is acquired by reading continuously from a low frequency regionit is good also considering the constant in which what was read from the low frequency region differs from the thing read from the high frequency region as addition or multiplication being carried out.
[0055]
Although explanation of this embodiment was explained as what was realized based on H.26L and it explained based on ABT in H.26Land CAVLCThe image coding system which can apply this invention is not limited to H.26Land can choose from plurality the size of the block which performs orthogonal transformationand it is possible to apply to various image coding systems with

which the entropy code modulation adapted to the orthogonal transformation coefficient is used.

[0056]

[Effect of the Invention]

The image encoding method by this inventionan image decoding methodan image encoding apparatusan image decoding deviceand an image processing system acquire the following effectsas explained to details above. Namelywhen the size of the block which performs orthogonal transformation can be chosen from pluralityBy dividing the coefficient sequence which consists of an obtained orthogonal transformation coefficient into two or more coefficient sequences of the same size as the coefficient sequence in the block of the minimum sizeand performing entropy code modulation which was adapted for the coefficient sequence in the block of the minimum size to thisIt becomes possible to perform efficient entropy code modulationwithout [without it increases the number of the encoding tables in entropy code modulationand] making complicated an encoding table and its selection procedure.

[Brief Description of the Drawings]

[Drawing 1]H. It is a figure showing the orthogonal transformation block used in the adaptive block size orthogonal transformation (Adaptive Block size TransformsABT) of 26L.

[Drawing 2]It is a figure showing an example of the read method of the coefficient at 4x4 blocksand the coefficient sequence after read-out.

[Drawing 3]H. It is a figure which is used in the context adaptation variable length code (Context-based Adaptive Variable Length CodeCAVLC) of 26L and in which showing the encoding table of a run.

[Drawing 4]It is a figure showing the example which followed 8x8 blocks in read-out and division of the orthogonal transformation coefficient by this invention.

[Drawing 5]It is a figure showing the definition of the arrangement within the block of a basis of the coefficient sequence after division by this invention.

[Drawing 6]It is a figure showing the example which followed 8x8 blocks in another method of read-out of the orthogonal transformation coefficient by this inventionand division.

[Drawing 7]It is a block diagram showing the composition of the image processing system concerning an embodiment.

[Description of Notations]

1 -- An image processing system10 -- An image encoding apparatus11 -- Orthogonal transformation means12 [-- An image decoding device21 / -- An inverse-orthogonal-transformation means22 / -- A coefficient sequence constituent means23 / -- An entropy decoding means24 / -- Block selecting means.] -- A coefficient sequence division means13 -- An entropy-code-

modulation means14 -- A block selecting means20

DESCRIPTION OF DRAWINGS

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